Level 2 Inspections

Introduction

Level 2 inspections are walk-through evaluations of sources or control equipment. They are characterized as either **basic** or **follow-up**. A basic Level 2 inspection is intended to collect specific baseline data to evaluate the performance of the control device or source. A follow-up Level 2 inspection is conducted if any of the basic Level 2 inspection steps indicates that a problem might exist.

Level 2 inspections are characterized as basic and follow-up.

Because Level 2 inspections are walk-through evaluations, the inspector must enter the facility. However, data are gathered only from on-site, permanently mounted instruments and from specific observations. No portable instruments are used. Thus, it is important that the inspector evaluate the accuracy of the data collected from these on-site instruments.

Plant entry is required.

Use only on-site, permanently mounted instruments.

Basic Level 2 Inspection

A basic Level 2 inspection includes all the steps in a Level 1 inspection (evaluation of visible emissions, condensing plume conditions, and fugitive emissions), plus additional steps whose use depends on the type of control equipment being inspected.

Additional Steps Common To All Basic Level 2 Inspections

These additional steps that are common to basic Level 2 inspections for all types of control equipment are to: evaluate the transmissometer, record process operating variables, and evaluate physical conditions of the control device.

A common step in a Level 2 inspection is evaluating the transmissometer (if it exists at the source) and its associated opacity data.

Evaluate the transmissometer. If the transmissometer is present and accessible, the inspector should check the light source and the retroreflector modules to confirm that they are in good working order. The inspector should also check to be sure that the main fan is working and that there is at least one dust filter for the fan. On many commercial models, it is also possible to check the instrument alignment.

The inspector should ask plant personnel to perform the calibration, zero, and span checks and to record the data. On some transmissometers, moving the dial to the alignment check position will cause an alarm to sound in the control room; therefore, the dial should be moved only by plant personnel and only when it will not disrupt safe plant operations. If the transmissometer appears to be working properly, the inspector should evaluate the average opacity data recorded 8 hours before the inspection.

If possible, the inspector should review the average opacity data for selected days since the last inspection. When reviewing the average opacity data, the inspector should scan the data to determine the frequency of emission problems and to evaluate how rapidly the operators are able to recognize and eliminate those problems.

An evaluation of opacity data can help confirm that the units being inspected are operating in a representative fashion. If the units are working better during the inspection than during other periods, it might be advisable to conduct an unscheduled inspection in the future.

Record key process operating parameters that can affect the emission levels.

Record process operating variables. Another additional step in basic Level 2 inspections is to record any process operating parameters that have an effect on the characteristics and/or quantities of generated pollutants. These variables include:

- Quantity and type of fuel being burned.
- Quantity and type of raw material used in the process.
- O_2 levels.
- Gas-stream temperature.
- Static pressure.

Evaluate the control device's physical condition.

On negative pressure units, check for audible air infiltration.

On positive pressure units, check for signs of fugitive emissions or dust.

Evaluate the device's physical condition. A third additional step in basic Level 2 inspections is to evaluate the control device's physical condition. The inspector should walk around the control device and its inlet and outlet ductwork to check for obvious leaks, corrosion, and erosion points. This includes inspecting hoppers and access hatches. On negative pressure units, the inspector should check for audible air infiltration through any corroded areas, warped access hatches, or eroded discharge valves. On positive pressure units, the inspector should check for fugitive emissions of dust from any corroded areas.

Additional Steps Related To Specific Control Equipment

The common steps just described should be supplemented, as appropriate, with other steps unique to specific types of control equipment, such as fabric filters, dry and wet scrubbers, mechanical collectors, carbon bed adsorbers, thermal and catalytic incinerators, and ESPs.

Fabric Filters

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of fabric filters.

If the fabric filter's operating temperature drops substantially, bag blinding can occur.

Evaluate operating temperatures. The inspector should evaluate the operating temperatures of all fabric filters. If the fabric filter's operating temperature drops substantially, vaporous material can condense inside the equipment and cause fabric blinding. Corrective action should focus on the process equipment, which is usually the source of the vaporous material.

Evaluate the fabric filter's static pressure drop. If the gauge face is working properly, the inspector should record the fabric filter's static pressure drop. The gauge face should be clear of obvious water and deposits. The gauge should fluctuate slightly each time one of the diaphragm valves activates. (These valves can be easily heard when one is close to the pulse jet baghouse.) If there is any question about the gauge, ask plant personnel to disconnect each line one at a time to see if the gauge responds. If the gauge does not move, it might be because a line is disconnected or plugged, or because the gauge is inoperable.

Record static pressure drop for the fabric filter if the gauge is working properly.

Because fabric filters operate with a wide range of static pressure drops (2 to 12 in.), it is best to compare the present pressure drop readings with the baseline values for the source being inspected. Increased static pressure drops generally indicate high gas flow rates, fabric blinding, or system cleaning problems. Lower static pressure drops are generally caused by reduced gas flow rates, excessive cleaning intensities/ frequencies, or reduced inlet particulate loadings.

Fabric filters operate with static pressure drops from 2 to 12 in.

An increased pressure drop indicates high gas flow rates, fabric blinding, or cleaning problems.

Evaluate the clean-side conditions (when possible). The inspector should ask plant personnel to open one or more hatches on the clean side (not available on some commercial models) of the fabric filter. Fresh dust deposits that are more than 1/8-in.-deep indicate potential particulate matter emissions problems.

Evaluate clean side deposits if plant personal can open the appropriate hatches.

The inspector should also observe the conditions of the bags, cages, and compressed air delivery tubes of pulse jet fabric filters. The compressed air delivery tubes should be pointed directly into the bags so that the sides of the bags are not subjected to the blast of cleaning air. In units where the bag comes up through the tube sheet, the cages and bags should be securely sealed to the tube sheet.

For reverse air and shaker units, the inspector should observe the bag tension and the status of the bag attachments at the tube sheet. In reverse air baghouses, the bags should have noticeable tension in the vertical direction (some inward deflection of the bags is normal when a compartment is isolated). In shaker units, the bags should not be under any tension and should not be slack. The majority of bag problems usually occur within the bottom 1 to 2 feet of the bags in both types of baghouses. Inspectors should observe conditions from the access hatches and should not enter the compartments under any circumstances.

Dry Scrubbers

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of dry scrubbers.

Evaluate SO_2, NO_x, and HCl monitors and their data. If the monitors are accessible, the inspector should confirm that the instruments are in good mechanical operating condition and that sample lines are intact. The inspector should have the plant's quality assurance staff perform an audit and should also check the calibration span and zero check records for all instruments and record that data. If the gas monitors are working properly, the inspector should evaluate the average emission concentrations recorded 8 hours before the inspection. If possible, the inspector should also review the average emissions for specified days since the last inspection. (This evaluation is helpful in confirming that the units being inspected are operating in a representative fashion.)

High emission rates of SO_2 or HCl indicate significant problems with the dry scrubber system. General problems include, but are not limited to, poor alkaline reagent reactivity, inadequate approach-to-saturation (wet-dry systems), low reagent stoichiometric ratios, low inlet gas temperatures, and make-up reagent supply problems. Follow-up Level 2 inspection procedures or Level 3 inspection procedures will be necessary if high emissions rates of SO_2 or HCl are observed.

Evaluate the spray dryer absorber's approach-to-saturation. One of the most important operating parameters affecting the efficiency of a wet-dry-type dry scrubber system is the approach-to-saturation. This is simply the difference between the readings of the wet bulb and dry bulb temperature monitors at the point where the gas stream leaves the spray dryer vessel. The normal approach-to-saturation for coal-fired-boiler systems varies between 15 to 50 °F, with most systems attempting to maintain a 20 to 25 °F value. Very high differences indicate lower acid gas removal efficiencies than during the baseline period.

Because these temperature monitors are vulnerable to scaling and blinding, the inspector should not be surprised to find that some plants occasionally bypass the automatic process control system by operating manually for a limited time. This generally results in slightly worse approach-to-saturation values—operators will then have a margin for error in the event of sudden process changes, such as load changes. Plants should be able to increase gradually the reliability of the temperature monitors by relocating sensors and by improving dryer operations.

Evaluate spray dryer absorber reagent feed rates. The inspector should evaluate $Ca(OH)_2$ (or other alkali) feed rates because they partially determine the stoichiometric ratio between the moles of reagent and the moles of acid gas. Low stoichiometric ratios result in reduced efficiencies. The reagent feed rate is generally determined using a magnetic flow meter on the slurry supply line to the atomizer feed tank. It is also necessary to know the slurry density, which is monitored by a density monitor. Typical slurry densities range from 5 to 2[illegible] percent by weight. It should be noted that both the magnetic flow meter and the density meter are vulnerable to scaling because of the characteristics of the slurry.

The inspector can determine the reagent feed rate by using weigh-belt feeders. He or she can record the feed rates of new pebble lime and recycled solids indicated by these feeders. The weigh belt for the pebble lime is located between the lime storage silo and the slaker. The weigh-belt feeder for the recycled solids is located close to the vessel of the spray dryer absorber. The inspector should compare both the slurry feed rates and the solids rates with baseline values at a similar combustion system load to determine if the stoichiometric ratio has dropped significantly.

Evaluate the spray dryer absorber's nozzle air pressures and slurry pressures. For units equipped with nozzles rather than with rotary atomizers, the inspector should record air pressures and slurry pressures and compare these values with baseline levels. Some variation in the slurry pressures is necessary to maintain proper approach-to-saturation values during variations in combustion system loads.

Evaluate the feed rates of dry injection systems. The feed rate of $Ca(OH)_2$ to the pressurized pneumatic system is usually monitored by a weigh-belt feeder or a volumetric screw-type feeder. Both of these feeders are located close to the $Ca(OH)_2$ storage silos, and the feed rates are usually indicated on the main system control panel. The inspector should record these values from 8 hours prior to the inspection. These values should then be compared against baseline values for similar combustion load periods. Decreased reagent feed rates indicate possible reductions in the stoichiometric ratio, thereby reducing the effectiveness of acid gas collection. The inspector should then record the blower motor currents and the pneumatic-line static pressures and compare these data to baseline data.

Evaluate calcium silicate feed rates. The spray absorber/dry injection system uses a calcium silicate/$Ca(OH)_2$ dry injection system downstream from the $Ca(OH)_2$ spray dryer absorber. The feed rate of calcium silicate/$Ca(OH)_2$ is monitored by weigh-belt feeders or volumetric screw conveyors. The inspector should record the feed rates from 8 hours prior to the inspection and compare them to baseline values.

Evaluate the recycling rates of control device solids. The inspector should record the solids recycling rates during the inspection and compare them to baseline values.

Wet Scrubbers

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of various types of wet scrubbers.

Evaluate the wet scrubber's static pressure drop. The wet scrubber's static pressure drop should be recorded if the gauge is working properly. The pressure change across a control device is an indicator of conditions existing within the device. This pressure change, called pressure drop, is defined as the static pressure at the inlet to the device minus the static pressure at the outlet from the device. Mathematically,

Record the static pressure drop if the gauge is working properly.

the pressure drop is represented by the equation $P_i - P_o$, in which P_i is the inlet gauge pressure and P_o is the outlet gauge pressure.

Increased static pressure drop for wet scrubbers indicates potential problems.

In general terms, any increase in resistance to air movement through a device will increase the pressure drop across the device. Conversely, any change that reduces the resistance to air flow will decrease the pressure drop. This is true for both positive- and negative-pressure devices. Although in reality no equipment operates at a negative pressure, devices that operate at less than atmospheric pressure are called negative-pressure devices. Converting all pressures to absolute pressures makes it easier to understand the impact of pressure drop on the performance of equipment.

Check the following items to confirm the adequacy of the on-site gauge:

- The face of the gauge should be clear of obvious water and deposits.
- The lines leading to the inlet and outlet of the scrubber should be intact.

If there is any question concerning the gauge, ask plant personnel to disconnect each of the lines one at a time to see if the gauge responds. If the gauge does not move when a line is disconnected, the line might be plugged or the gauge might be inoperable. (Note: The lines should be disconnected by plant personnel only, and only when this will not affect safe plant operations.)

Static pressure drop is not a useful inspection parameter for spray tower wet scrubbers.

Wet scrubber systems operate with a wide range of static pressure drops, as indicated in Table 12-1 below. Data are not provided for spray tower scrubbers because static pressure drop is not a useful inspection parameter for this type of unit.

Table 12-1. Static Pressure Drops For Wet Scrubber Systems

Scrubber System	Pressure Drop (in. of water column [w.c.])
Packed bed	2 - 6
Tray tower	2 - 12
Mechanically aided	2 - 12
Orifice	4 - 25
Rod-type	10 - 120
Venturi	10 - 120

Because of differences in particle size distributions, there is a wide range of required static pressure drops for identical wet scrubbers operating on similar industrial processes. Thus, the inspector should compare the present readings with the baseline values for the source being inspected.

Table 12-2 might be useful in evaluating the internal conditions of wet scrubbers.

Table 12-2. Conditions Related To Changes In Static Pressure Drop Across Wet Scrubbers

Scrubber System	Observation of Pressure Drop	Conclusion
Packed bed	Higher than normal	Partial bed pluggage
	Lower than normal	Collapsed bed or channelling
Tray tower	Higher than normal	Partial tray pluggage
	Lower than normal	Collapsed trays
Mechanically aided	Higher than normal	Faster than normal rotating speed
	Lower than normal	Slower than normal rotating speed
Orifice	Higher than normal	Higher than normal liquid flow rate (float gauge alignment)
	Lower than normal	Lower than normal liquid flow rate (pump failure)
Venturi and rod type	Higher than normal	Higher than normal liquid flow rate and/or reduced throat area (possible obstruction/ corrosion)
	Lower than normal	Lower than normal liquid flow rate and/or expanded throat area (possible eroded rods or missing rods)

Evaluate the liquor inlet pressure. The pressure of the header that supplies the scrubber spray nozzle can provide an indirect indication of the liquor flow rate and the nozzle condition. A present value lower than the baseline value indicates that the liquor flow rate has increased and that the nozzle orifice might be eroded. Conversely, a present value higher than the baseline value indicates that the liquor flow rate has decreased and that the nozzle and/or header might be plugged.

Pressure gauges on wet scrubbers are vulnerable to error because of solids deposits and corrosion. Care should be taken in using these gauges.

Unfortunately, these pressure gauges are very vulnerable to error because of solids deposits and corrosion. It is difficult to confirm that they are working properly. For these reasons, other indicators of low liquor flow, such as the pump discharge pressure and the outlet gas temperature, should be checked by the inspector whenever low header pressure or pipe pressure is observed.

To test for liquor turbidity, ask a plant representative to obtain a sample of the liquor entering the scrubber vessel.

Evaluate the liquor turbidity and solids settling rate. The inspector should ask a responsible and experienced plant representative to obtain a sample of the liquor entering the scrubber vessel. This can usually be obtained at a sample tap located downstream from the main recirculation pump. The inspector should provide a clear sample bottle. The scrubbing liquid can absorb only a given amount of solids at a specific temperature and pressure. Thus, the presence of suspended and/or dissolved particles affects the collecting efficiency of the scrubber.

The inspector should observe the turbidity of the liquor for a few seconds immediately after the sample is taken. The turbidity should be described as clear, very light, light, moderate, heavy, or very heavy. After allowing the sample to settle for 5 minutes, the inspector should evaluate the liquor turbidity again and describe the thickness of the settled solids.

Mechanical Collectors

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of mechanical collectors.

Ensure that the static pressure gauge is operating properly, and then record the static pressure drop.

Evaluate the mechanical collector's static pressure drop. The inspector should record the collector's static pressure drop if the gauge is working properly. The gauge face should be clear of water and deposits, and the gauge valve should respond to changes in the process operating rate. The lines leading to the inlet and outlet of the collector should be intact.

If there is any question concerning the gauge, ask plant personnel to disconnect each of the lines one at a time to see if the gauge responds. If the gauge does not move when a line is disconnected, the line might be plugged or the gauge might be inoperable. (Note: The lines should be disconnected by plant personnel only, and only when this will not affect plant safety or operations.)

If the on-site gauge is working properly, the inspector should record the indicated values. The time that the data were obtained should also be noted if the process operating rates change frequently.

The observed static pressure should be corrected for the present operating rate by using the equation below. The corrected value should then be compared with baseline values.

$$C_{sp} = O_{sp} (X^2/B^2)$$

where:

C_{sp} = corrected static pressure drop, in. w.c.
O_{sp} = observed static pressure drop, in. w.c.
X = present process operating rate
B = baseline process operating rate

If the corrected static pressure drop is significantly different from the baseline values, then the gas flow resistance has changed, and particulate emissions have probably increased.

Increased static pressure drops usually indicate solids buildup in the collector, most commonly on the inlet spinner vanes of small-diameter multicyclone tubes. This causes poor vortex formation and reduced collection efficiency in the affected tubes.

Increased static pressure drop generally indicates solids buildup in the mechanical collector.

Low static pressure drops are usually caused by erosion of the outlet extension tubes, corrosion of the clean-side tube sheet, or failure of the tube gaskets. These problems allow some of the particulate-laden flue gas to "short circuit" the collector.

Evaluate solids discharge valves and solids discharge rates. For multicyclone collectors using rotary discharge valves or flapper valves, the inspector should check (if safely possible) for continuous movement of the valve and for continuous discharge of solids into the screw conveyor or into the disposal container. For multicyclone collectors using pneumatic or pressurized hopper discharge systems, the inspector should check for the sound of discharge valves opening and closing. (Note: Only plant personnel should open observation hatches on screw conveyors or dust storage/disposal containers. Protective goggles and respirators might be needed in some cases.)

Check the operation of discharge valves to ensure that solids are being properly discharged.

Carbon Bed Adsorbers

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of carbon bed adsorbers.

Evaluate the VOC outlet detector. VOC detectors, often used at the outlet of carbon bed systems, are relatively sophisticated instruments that require frequent maintenance. The inspector should confirm that the detector is working properly by reviewing the calibration and maintenance

Confirm that the VOC outlet detector is working properly.

records since the previous inspection. Plant operating records should also be briefly reviewed to determine if the instrument has been operating continuously. (Check the results of calibration tests with recorded operating data to see if the times, dates, and readings match.)

Check the carbon bed shell for obvious corrosion. Some organic compounds collected in carbon bed systems can react during steam regeneration. This leads to severe corrosion of the unit's shell and of the screens that retain the carbon beds.

Determine the time intervals between bed regeneration. Increased time intervals could indicate breakthrough problems.

Observe the adsorption/desorption cycles. The inspector should determine the time interval between bed regenerations and compare this with baseline values. An increase in this time interval could mean that breakthrough is occurring and quantities of organic vapor are being emitted. If the cycle is significantly shorter, then the absorbant might be damaged and no longer suitable.

Decrease in steam line pressure could mean less-than-necessary steam flow for carbon bed regeneration.

Check the pressure of the regeneration steam line. Any decrease in the steam-line pressure from previously recorded levels could indicate less-than-necessary steam flow for regenerating the carbon beds.

Thermal and Catalytic Incinerators

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of thermal and catalytic incinerators.

Observe the incinerator bypass stack. Incinerators usually must have bypass stacks so that the process equipment can be safely vented if the incinerator should malfunction. However, during routine operation, there should be no significant leakage of VOC-containing gas through the bypass stack dampers. Check records on the frequency of bypass stack use.

Reduced incinerator operating temperature could mean reduced VOC reduction efficiency.

Record the operating temperature of the incinerator. For thermal incinerators, the inspector should record the combustion chamber's exhaust-gas temperature. This temperature is usually controlled by a thermocouple and an electronic controller, which adjust the main burner firing rate. A reduction in the operating temperature could mean reduced oxidation efficiency for VOCs.

Smaller-than-normal temperature increases for a catalytic incinerator indicate that either the catalyst is being inhibited or there is a reduced VOC concentration in the inlet gas stream.

Inspection of catalytic incinerators, should include a review of the catalyst bed's inlet and outlet gas temperatures. The inlet gas temperature is the temperature registered after the preheater burner and immediately ahead of the catalyst bed. The bed outlet temperature is the temperature recorded before the gas stream enters any of the heat-recovery equipment. Smaller-than-normal temperature increases across the catalyst bed are caused either by catalyst inhibition or by a reduced VOC concentration in the inlet gas stream.

Listen for air infiltration into the incinerator system. Air infiltration into negative pressure incinerators (fan is located downstream of the incinerator) can lead to localized cooling of the gas stream. Severe air infiltration into the inlet duct reduces the sensible heat. Incinerators operate most effectively within narrow ranges of temperature. Infiltrated air requires heat to bring the air up to the auto-ignition temperature of the VOCs. Infiltration also reduces the VOC capture effectiveness at the process source.

Air infiltration reduces VOC capture effectiveness.

ESPs

The following inspection steps are designed to further aid the inspector when performing a basic Level 2 inspection of ESPs.

Evaluate the T-R set's electrical data. The first step in evaluating the T-R set electrical data is to obtain or prepare a sketch that indicates how the T-R sets are arranged on the precipitator. This drawing should indicate the number of chambers in the precipitator and the number of T-R sets in series in each chamber. The T-R set numbers should be included on the sketch.

For each chamber, the T-R set's electrical data should be recorded, starting with the inlet field and proceeding to the outlet field. In some cases, the control cabinets are scrambled. The inspector should record the following data:

Record key data from T-R electrical instruments (voltage, current, and spark rate).

- Primary voltage (volts)
- Primary current (amps)
- Secondary voltage (kilovolts)
- Secondary current (milliamps)
- Spark rate (no./min.)

The voltages and currents should be recorded when the gauge has reached the highest stable value for approximately 1 second or more. If there is any question about the adequacy of the spark-rate meter, determine the spark rate by counting the number of fluctuations of the primary-voltage and/or secondary-voltage meters.

The inspector should also compare the secondary and/or primary voltages against baseline levels and against typical values for the unit. Generally, the primary voltages are above 250 volts (a.c.), and the secondary voltages usually range from 20 to 45 kilovolts (d.c.). A drop in the secondary voltage of 5 kilovolts (d.c.) in any given field indicates significantly reduced particulate-control capability for that field.

Compare data to baseline values.

To check particle resistivity, the inspector should plot the voltages, currents, and spark rates for each of the chambers and compare these drawings with similar drawings prepared from baseline data. If all or most of the fields in a chamber have shifted in the same direction at approximately the same time (outlet fields often lag several hours), there

Review particle resistivity data.

has probably been a significant shift in the particle resistivity. The symptoms of resistivity shifts are summarized below.

- Higher Resistivity
  Increased primary or secondary voltages
  Reduced primary or secondary currents
  Increased spark rates

- Lower Resistivity
  Reduced primary or secondary voltages
  Increased primary or secondary currents
  Decreased spark rates

In some units, the resistivity conditions in one chamber are quite different from the resistivity conditions in other adjacent chambers. In these types of units, the changes in the secondary voltages and currents are much greater in some of the chambers. This condition is often caused by slight differences in the flue-gas temperatures entering the various chambers and/or by maldistribution of resistivity-conditioning materials injected into the system.

Follow-up Level 2 Inspection

Follow-up Level 2 inspections are specific to the data and information obtained during a basic Level 2 inspection. As a result, the steps in a follow-up Level 2 inspection are specific to the type of control device being inspected.

Fabric Filters

The following inspection steps are designed to further aid the inspector when performing a follow-up Level 2 inspection of fabric filters.

Check the operation of the compressed air system.

Evaluate the compressed air cleaning system (pulse jet fabric filters). The inspector should record the compressed air pressure if the gauge is working properly. It should fluctuate slightly each time a diaphragm valve is activated. Because the compressed air lines and manifold have high-pressure air inside, the inspector should exercise care during the inspection of this system.

The inspector should then listen to determine if the diaphragm valves are operating; check the compressed air shutoff valve to confirm that the line is open; count the number of diaphragm valves that do not activate during a cleaning sequence; check for an oil filter on the compressed air dryer; and check for a drain on the compressed air supply pipe or on the air manifold.

Confirm reverse air fan operations (on reverse air fabric filters). The inspector should confirm that the reverse air fan is operating by noting if the fan shaft (located near the top of the baghouse) is rotating.

Confirm the operation of fans, shaker assemblies, and cleaning equipment, as appropriate.

Confirm operations of the shaker assemblies (on shaker fabric filters). The inspector should confirm that each of the shaker assemblies is working by observing the movement of the shaker linkages on the outside of each compartment.

Confirm operations of the cleaning equipment controllers (on reverse air, shaker, and some multicompartment pulse jet fabric filters). The inspector should observe the baghouse control panel during cleaning of one or more compartments to confirm that the controller is operating properly. Before the static pressure drop increases to very high levels, determine whether or not each compartment to be cleaned is isolated.

It is usually good practice for the inspector to allow a short null period (from 5 to 30 seconds) between the time a compartment is isolated and the time that reverse airflow or shaking begins. This period reduces the flexing wear on the fabric. It is also good practice to have a null period of from 15 to 60 seconds following cleaning to allow fine dust to settle out of the bags before they are returned to filtering mode.

Evaluate gas temperature records. The inspector should review selected strip charts to determine if the gas inlet temperatures have been above the maximum-rated fabric temperature, below the acidic vapor condensation temperature, or above the water-vapor dew point.

The average inlet gas temperature should be from 25 to 50 °F below the maximum-rated temperature limit of the fabric. Fifteen- to 30-min spikes of less than 25 °F above the maximum-rated limit can usually be tolerated without fabric damage.

Determine the average gas inlet temperature (25 to 50 °F).

The average inlet gas temperature should also be from 25 to 50 °F above the acid-gas dew point temperature. For most commercial combustion processes, the acid dew point is 225 to 300 °F. The inlet gas temperature should also be above the water-vapor dew point.

Evaluate bag failure records. The inspector should plot the number of bag failures per month from the last 6 to 24 months. If there has been a sudden increase in failures, the bags in the affected compartments might need to be replaced.

Plot and evaluate the number of bag failures per month.

Evaluate fugitive emissions from process equipment. A careful check for process fugitive emissions is always desirable, especially when the baghouse's static pressure drop is substantially higher than the baseline value or when air infiltration is suspected. In such cases, poor capture of the dust at the process equipment is possible. The inspector should walk around the process sources (if it is possible to do so safely) to evaluate pollutant capture.

If static pressure drop is higher than normal, or if air infiltration is suspected, then possible fugitive emissions from process equipment should be investigated.

Dry Scrubber

The following inspection steps are designed to further aid the inspector when performing a follow-up Level 2 inspection of dry scrubbers.

Review CEM data. The inspector should obtain the CEM records and quickly scan the data from the previous 6 to 12 months to determine time periods with unusually high or low emission rates. The inspector should then select the dry scrubber's operating logs and the process operating logs that correspond with the times of the monitoring instruments' charts/records. The inspector should compare the dry scrubber operating data and process operating data against baseline information to identify periods of excess emissions, and evaluate the corrective actions employed by the source.

Evaluate the spray dryer absorber's approach-to-saturation values during the previous 6 to 12 months. If there is a significant question concerning the ability of the dry scrubber system to maintain proper operation on a long-term basis, the approach-to-saturation values indicated on the scrubber's daily operating log sheets should be checked. Values much higher than baseline values or permit conditions may indicate chronic problems in the following areas:

- Absorber vessel temperature instruments.
- Absorber vessel atomizer.
- Absorber gas dispersion equipment.
- Low absorber vessel inlet gas temperatures during load periods.
- Nozzle erosion or blockage.
- Slurry supply line scaling.

Evaluate reagent feed-rate data from the previous 6 to 12 months. The feed rates of make-up pebble lime and recycling solids are usually indicated on the daily operating logs of the dry scrubber system. Values from the previous 6 to 12 months should be compared with the corresponding combustion-load data to determine if significant changes in the overall reagent stoichiometric ratios have occurred. Data concerning the system load must be obtained from the combustion system's daily operating log sheets. If available, inlet SO_2 concentrations should also be used in this qualitative evaluation of reagent/acid gas stoichiometric ratios.

Evaluate slaker slurry outlet temperatures from the previous 6 to 12 months. The slaker slurry outlet temperature provides a rough indication of the adequacy of the conversion from lime (CaO) to $Ca(OH)_2$. The inspector should compare these temperature to baseline values. Improper slaking can result in poor reagent reactivity and reduced acid-gas-collection efficiency.

Evaluate slurry flow rates and density monitor maintenance records. The $Ca(OH)_2$ slurry monitors generally consist of a magnetic flow meter and a density meter. Both of these are sensitive to scaling, especially when slurry densities are high. The plant should have maintenance records, such as work orders, a computerized maintenance record, an instrument maintenance log, or notes on the daily dry scrubbing operations log. These records from the previous 6 months to 2 years should be reviewed whenever there is concern that there are periods of low slurry supply to the atomizer.

Evaluate inlet gas temperatures from the previous 6 to 12 months. Dry scrubbing systems have a limited turndown capability because of the need for complete drying of the atomized slurry. Low gas-inlet temperatures during periods of low combustion-system load can cause poor drying of the droplets. The process control system is usually designed to block atomizer operation if the inlet temperature drops below a preset value. The inlet gas temperature data should be reviewed to confirm that the controller is working properly, because operating under these conditions could lead to absorber-vessel deposits and non-ideal operations if loads increase. The inlet temperature data should be available on the dry scrubber system's daily operating logs, on the archived continuous strip charts, or on the computerized data-acquisition flow records.

Evaluate the dry injection system's feed rates from the previous 6 to 12 months. A gradual long-term increase in emissions might indicate performance problems with the $Ca(OH)_2$ supply system. The feed-rate data from the previous 6 to 12 months should be compared with the combustion-system loads and with the inlet acid-gas monitoring data. The automatic control system should be evaluated to determine if it is adequately controlling the $Ca(OH)_2$ (or other alkali) addition rates as the loads or acid-gas concentrations vary.

Evaluate calcium silicate/$Ca(OH)_2$ feed rates from the previous 6 to 12 months. The variability and reliability of the calcium silicate/$Ca(OH)_2$ dry injection system in the spray absorber/dry injection systems should be evaluated by reviewing the daily system-operation logs. Some loss in acid- gas-collection efficiency can occur if feed rates are low.

Evaluate the recycling rates of solids in the dry injection system's control devices. The recycling rates used in the spray absorber/dry injection systems have some effect on the overall acid-gas-collection efficiency. Changes in the recycling rates might indicate reduced acid-gas-collection efficiency.

Wet Scrubbers

The following inspection steps are designed to further aid the inspector when performing a follow-up Level 2 inspection of wet scrubbers.

Check that pH meters are operating properly by reviewing calibration records.

Check liquor pH. The inspector should locate the on-site pH meter. Permanently mounted units are usually attached to the recirculation tank or the liquor outlet lines from the scrubber vessel. The inspector should confirm that the instrument is working properly by reviewing the routine calibration records. In some cases, it is possible to watch plant personnel calibrate these instruments during the inspection. If the pH meter is working properly, review the pH data from at least the previous month. For units with instruments on the outlet and the inlet sides, the outlet values are often 0.5 to 2.0-pH units lower because of the absorption of CO_2, SO_2, or other acid gases. Generally, all of the pH measurements should be within the range of 5.5 to 10.0. Furthermore, any significant shifts of the pH values from baseline conditions can indicate operating problems with the wet scrubber.

Shifts in pH values can indicate operating problems in the scrubber system.

Corrosion is a potential problem if pH levels are less than 5.5.

In most systems, corrosion can be severe when the pH levels are less than 5.5. Also, high chloride concentrations accelerate corrosion at low-pH levels. Precipitation of calcium and magnesium compounds at pH levels above 10 can lead to severe scaling and gas-liquor maldistribution.

A poor liquor recirculation rate can cause an increase in emissions.

Some liquor flow monitors are subject to frequent maintenance problems.

Evaluate the recirculation rate of the scrubber liquor. One frequent cause of scrubber emission problems is an inadequate liquor recirculation rate. Unfortunately, many commercial liquor-flow monitors are subject to frequent maintenance problems, and many small systems do not have any liquor-flow meters at all. For these reasons, the inspector should consider a combination of factors to determine if the scrubber-liquor recirculation rate is much less than the baseline levels. These factors include the following:

- Liquor flow reading (if available and if the meter is working properly).
- Pump discharge pressure (higher values indicate lower flow).
- Pump motor current (lower values indicate lower flow).
- Nozzle header pressure (higher values indicate lower flow).
- Scrubber exit-gas temperature (higher values indicate lower flow).
- Quantity of liquor draining back into the recirculation tank or pond (lower flow rates indicate lower recirculation rates).

Evaluate gas flow rates. Changes in gas flow rates occur routinely in most processes because of variations in process operating rates and conditions. When evaluating changes in the scrubber's static pressure drop, the inspector should gather inform[illegible] concerning gas flow rate changes.

The inspector should also check the scrubber system's fan motor current and then correct the fan motor current to standard conditions using the equation below:

Corrected current = actual current x (gas temp. + 460)/520

An increase in fan motor current indicates an increase in gas flow rate.

An increase in the fan motor current indicates an increase in the gas flow rate.

Evaluate demister conditions. The inspector should evaluate the demister's physical condition if substantial liquor reentrainment has recently occurred. It should be noted, however, that there must be safe and convenient access hatches, and that there must not be any process gas in the scrubber during the inspection.

Deposits on demisters and the use of spray nozzles to clean the demisters should be noted.

The inspector should also note any deposits on the bottom or on the top of the demister. Deposits can lead to localized high-gas velocity areas, which, in turn, lead to liquor reentrainment. The inspector should note the appearance of any spray nozzles used for routine demister cleaning.

Whenever the static pressure drop is substantially higher than the baseline value, check for process fugitive emissions.

Evaluate fugitive emissions from process equipment. The inspector should carefully check for process fugitive emissions whenever the scrubber system's static pressure drop is substantially higher than the baseline value, or when air infiltration is severe. In both cases, poor capture of the dust at the process equipment is possible. If it is possible to do so safely, the inspector should walk around the process sources to determine if pollutant capture is adequate.

Mechanical Collectors

The following inspection steps are designed to further aid the inspector when performing a follow-up level 2 inspection of mechanical collectors.

Gas temperature drops that are higher than baseline values suggest air infiltration and reduced collection efficiency.

Evaluate air infiltration indicators. The inspector should locate any permanently mounted temperature gauges on the inlet and outlet ducts of the mechanical collector. The presence of a thermocouple is indicated by the presence of a thermocouple "head" connection in the ductwork. If the instruments appear to be in a representative location, check the indicated temperatures at the control room. Compare the inlet and outlet values. In most mechanical collectors that serve combustion processes, the gas temperature drop across the collector is 20 to 40 °F, depending primarily on the gas flow rate and the adequacy of insulation. Gas temperature drops that are higher than baseline values suggest significant air infiltration and reduced particulate-matter-collection efficiency.

The inspector should also compare the inlet gas temperatures with the baseline levels. If there is a significant difference, the inspector should check the process operating rate and process operating conditions. On units having O_2 monitors, the inspector should check the increase in flue-gas O_2 concentration across the collector. In most cases, the increase in O_2 concentration should be less than 1 percent (e.g., 7 percent inlet, 8 percent outlet).

Summary

A Level 2 inspection is a walk-through evaluation. A basic Level 2 inspection is used to collect specific baseline data. A follow-up Level 2 inspection is used when the basic inspection indicates a potential problem that might need to be looked at further.

The inspector must enter the facility to gather the data, which are obtained from on-site, permanently mounted instruments and from observations.

All basic Level 2 inspections include the inspection steps found in a Level 1 inspection. Additional Level 2 inspection steps depend on the type of control equipment being inspected.

Review Exercises

1. The purpose of a basic Level 2 inpsection is to:

   a. Collect specific baseline data
   b. Evaluate performance of an air pollution control device
   c. a and b
   d. None of the above

2. True or false? Portable instruments are used to record data during a Level 2 inspection.

3. True or false? Level 2 inspections involve recording key process parameters and evaluating a control device's physical condition.

4. Level 2 inspections are characterized as ______________ and ______________.

5. True or false? The inspector does not have to enter the plant to conduct a Level 2 inspection.

6. True or false? On positive pressure fabric filters, the inspector should check for audible air infiltration.

7. Fabric filters operate with static pressures of from ______ to ______ inches.

8. Increased pressure drop in a fabric filter might indicate:

   a. High gas flow rates
   b. Fabric blinding
   c. Cleaning problems
   d. All of the above
   e. None of the above

9. True or false? Static pressure drop is a useful inspection parameter for spray tower wet scrubbers.

10. Pressure gauges on wet scrubbers are vulnerable to error because of _________ and _________.

11. Reduced incinerator operating temperatures could mean:

    a. Reduced VOC oxidation efficiency
    b. Increased VOC oxidation efficiency
    c. Colder inlet gas stream
    d. None of the above

12. Does air infiltration usually reduce or increase VOC capture effectiveness?

13. What problem does a shift in pH indicate for a wet scrubber?

14. In wet scrubbers, corrosion is a potential problem with pH levels of less than _____.

15 An increase in fan motor current indicates a(n) ________ in gas flow rate.

a. Increase
b. Decrease

16. For mechanically aided scrubbers, increased rotational speed over baseline values indicates:

a. Higher than normal flow rate
b. Higher than normal static pressure
c. Lower than normal flow rate and static pressure
d. a and b
e. None of the above

17. A decrease in static pressure drop for carbon bed systems could indicate:

a. Channeliing
b. The need for bed regeneration
c. Lower operating temperatures
d. None of the above

18. Higher rapper intensities for fabric filters could indicate:

a. Higher resistivity dusts
b. Binding or broken rapper shaft connections
c. Poor startup procedures
d. All of the above
e. None of the above

Answers

1. c. a and b
2. False. Only permanently mounted instruments are used to gather data in a Level 2 inspection.
3. True
4. Basic, follow-up
5. False. The inspector must enter the facility during a Level 2 inspection.
6. False. Only negative pressure fabric filters need to be checked for air infiltration.
7. 2, 12
8. d. All of the above
9. False. Static pressure drop is not a useful inspection parameter for spray tower wet scrubbers.
10. solid deposits, corrosion
11. a. Reduced VOC oxidation efficiency
12. Reduce
13. An operating problem
14. 5.5
15. a. Increase
16. e. None of the above
17. a. Channelling
18. d. All of the above